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Camera System Creates Sophisticated 3-D Effects By JOHN MARKOFF Published: July 31, 2006

PALO ALTO, Calif. — In a darkened garage here, Steve Perlman is giving digital actors a whole new face.

A former Apple Computer engineer who previously co-founded WebTV Networks and the set-top box firm Moxi, Mr. Perlman is now putting the finishing touches on Contour, a futuristic camera system that will add photorealistic three-dimensional effects to digital entertainment. The new system will be introduced today at the Siggraph computer graphics conference in Boston, and effects created with it could start appearing as early as next year.

The system could change the nature of cinematography in several ways, according to leading Hollywood producers and technologists who are planning to use the system. For example, it will make it possible to create compellingly realistic synthetic actors by capturing the facial movements of real actors in much greater detail than is currently possible.

David Fincher, who directed the films "Fight Club" and "Panic Room," is planning to use Contour next year when he begins filming "The Curious Case of Benjamin Button," a movie based on a short story by F. Scott Fitzgerald in which Brad Pitt will play a character who ages in reverse.

"Instead of grabbing points on a face, you will be able to capture the entire skin," Mr. Fincher said. "You're going to get all of the enormous detail and the quirks of human expression that you can't plan for."

The technology will let filmmakers transform the appearance of actors in the computer, raising the possibility of a new form of digital video in which the viewer can control the point of view — what is being described in Hollywood as "navigable entertainment."

The Contour system requires actors to cover their faces and clothes with makeup containing phosphorescent powder that is not visible under normal lighting. In a light-sealed room, the actors face two arrays of inexpensive video cameras that are synchronized to simultaneously record their appearance and shape. Scenes are lit by rapidly flashing fluorescent lights, and the cameras capture light from the glowing powder during intervals of darkness that are too short for humans to perceive.

The captured images are transmitted to an array of computers that reassemble the three-dimensional shapes of the glowing areas. These can then be manipulated and edited into larger digital scenes using sophisticated software tools like Autodesk's Maya or Softimage's Face Robot.

"Steve is really on to something here," said Ed Ulbrich, vice president of Digital Domain, a Hollywood special-effects company in Venice, Calif. "The holy grail of digital effects is to be able to create a photorealistic human being."

Until now, realistic digital actors have required significant amounts of computing power, at great expense.

"It's been used in stunts and big special-effects scenes," Mr. Ulbrich said. "Now you can use it for two actors sitting at a table and talking. You have the ability to tell stories and have close-up scenes that make you laugh and cry."

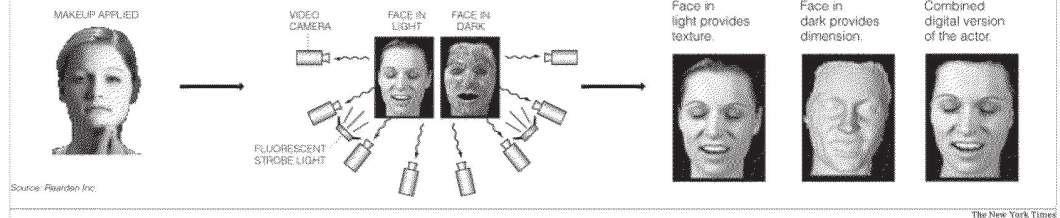
Capturing Human Details

New technology will allow filmmakers and video game creators to not only capture an actor's movements in three dimensions, but to recreate details of appearance and behavior, like a wrinkle in the hand or an arch of an eyebrow.

1 An actor's face, hands and clothing can be coated with a makeup that glows in the dark and is invisible under normal light.

2 The actor's face is lit with fluorescent lights that flash on and off faster than the eye can perceive. Video cameras record the scene from multiple angles and capture the face both with the lights on and as it glows in the dark.

3 Computers take the images and reconstruct a three-dimensional model of the actor that can be manipulated as desired in film or game production.



Mr. Perlman's system is a leap forward for a technology known as motion capture, now widely used in video games and in movies like "The Polar Express," which starred Tom Hanks in various digital guises.

Motion capture cuts the costs of computer animation while creating more natural movement. Today's motion-capture systems work by tracking the locations of hundreds of reflective balls attached to a human actor. This permits the actor's movements to be sampled by a camera many times per second. But the digital record is limited to movement, and does not include the actual appearance of the actor.

The difference offered by Mr. Perlman's technology is in the detail. Standard motion-capture systems are generally limited in resolution to several hundred points on a human face, while the Contour system can recreate facial images at a resolution of 200,000 pixels. The digital video images produced by the system are startlingly realistic.

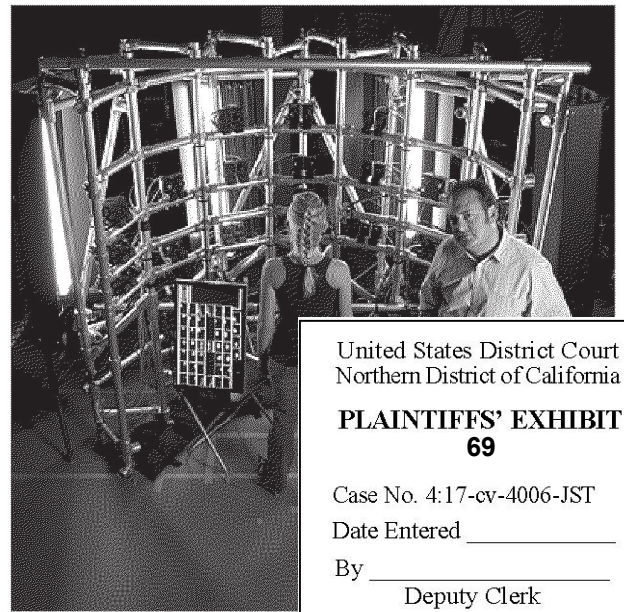
Mr. Perlman, who helped develop Apple's QuickTime video technology, said the computer-generated animation techniques pioneered by Pixar Studios were reaching a visual plateau and, as a result, losing some of their audience appeal.

But an important hurdle to commercial success for the Contour system is whether it will be the first low-cost technology to cross what film and robot specialists refer to as the "uncanny valley."

That phrase was coined in the 1970's by Masahiro Mori, the Japanese robotics specialist, as he sought to describe the emotional response of humans to robots and other nonhuman entities. He theorized that as a robot became more lifelike, the emotional response of humans became increasingly positive and empathetic — until a certain point at which the robot took on a zombie-like quality, and the human response turned to repulsion. Then, as the robot becomes indistinguishable from a human, the response turns positive again. Critics were quick to point out the eerie look of the characters in "Polar Express."

"We are programmed from birth to recognize human faces," Mr. Perlman said.

There are some limits to the new technology. For example, the Contour system can capture eyebrows, mustaches and short beards, but it is not able to capture freely moving strands. It is also not able to capture areas where makeup cannot be applied, like the eyes or the inside of the mouth. The Contour developers are now experimenting with plastic teeth molds with embedded phosphor powder.



United States District Court
Northern District of California

**PLAINTIFFS' EXHIBIT
69**

Case No. 4:17-cv-4006-JST

Date Entered _____

By _____
Deputy Clerk

Steve Perlman with the Contour system that could change the nature of cinematography. It is scheduled to be introduced Monday.

If the Contour system can be commercialized, it will allow digital film directors to easily and inexpensively control camera angles and generate elaborate visual fly-throughs in movies. It will also lower the cost of creating fantasy characters like Gollum in the "Lord of the Rings" trilogy.

In addition to films, the new system will be valuable in creating more realistic video games, Mr. Perlman said. A major video-game development company has committed to use the system in future games, he said, adding that he could not give its name at this time.

The Contour system has been developed by a small team of software and hardware engineers that Mr. Perlman has assembled in the garage of his home in Palo Alto, Calif., over the last three years. He rewired the garage to handle the power requirements of the lighting system and a small graphics supercomputer that was built from scratch. Contour will be distributed by Mova, one of a group of start-up firms that Mr. Perlman has assembled since he left WebTV in 1999, after it was purchased by Microsoft.

Contour is not the only attempt to develop more advanced digital cinematography techniques, said Richard Doherty, a digital media consultant who is president of Envisioneering Inc., in Seaford, N.Y.

"There are some upstarts in Los Angeles, but none have achieved the demonstrated scale and performance that Steve has shown," Mr. Doherty said. "This is the kind of technology that is celebrated, and it is on the scale of the invention of the Steadicam. He's going to give that kind of freedom to actors and directors."